

up in a mortar moistened with 0.1 per cent. sodium chloride solution, drops of the sodium chloride solution are added from time to time and the grinding continued until the clumps of bacilli are broken up as thoroughly as possible. The emulsion is then placed in a test tube and heated to 100 degrees for five minutes and sealed until ready for use.

When preparing for an estimation, the tube containing the emulsion is thoroughly shaken and centrifuged a few minutes to throw down the clumps. The upper layer, which should be quite opalescent, is pipetted off and placed in a watch glass.

The serum to be tested is obtained by making a light stab with a sharp capillary glass tube in the top of a finger near the nail. The blood which flows readily, is collected in a glass capsule having curved capillary ends, which are sealed when the capsule is about two-thirds filled with blood. It is then allowed to coagulate and hung by its curved arm over the ring of the centrifuge and revolved until the clear serum has collected above the clot. The top is now broken off, the serum removed with a capillary pipette and placed in a third watch glass properly marked. For the control test a glass capsule is filled in the same way with blood of several normal individuals and centrifuged as before. The blood of a number of normal people is used as a control to correct the error of individual variation in opsonic content.

The three preparations, washed white corpuscles, bacterial emulsion and serum, are measured and mixed with a capillary pipette having a mark about two centimeters from the end. The blood cells are drawn up to the mark, then a bubble of air is allowed to enter the tube and the same volume of bacterial emulsion drawn in, then another space of air is allowed to enter the tube and an equal volume of the serum to be tested drawn up and the three volumes carefully mixed by drawing up and down several times upon a slide. Finally the mixture is drawn into a pipette, the end of which is sealed in the flame and placed in the incubator with the control tube, which is prepared in the same way at the same time. After incubating fifteen or twenty minutes, the tube end is broken off and the mixture again mixed by drawing up and down on a slide. Two slides are prepared by smearing as in preparing blood smears, except that the preparation is made much thicker and allowed to dry slowly in the air. In this way the leukocytes can easily be found collected at the outer edge of the smear and counted. The slides are fixed in saturated bichloride of mercury for one minute and stained in carbofuchsin, destained in dilute sulphuric acid, and counterstained in methylene blue.

In counting, it is necessary to count only polynuclear leukocytes and to count only those in which the nucleus lies flat. In this way the error of counting is reduced to a minimum.

The best emulsion of tubercle bacilli is on which in the ordinary time of incubation shows one or two bacilli per cell and which does not contain clumps of bacilli. The length of time necessary for grind-

ing and centrifuging each culture of tubercle bacilli used must be ascertained by practice tests before beginning estimation.

DISCUSSION OF PAPERS BY DRs. PORTER AND MACE.

Dr. Evans—I think we ought to congratulate Dr. Mace on the degree to which he has perfected this technic. No one knows, except those who have tried it, the discouragements met with in this work. There are few points in the technic where he differs from Wright. For instance, the last part of his demonstration regarding the collection of the blood. I should imagine that he would be very apt to burn the blood in this way. Dr. Wright on the contrary, after allowing the blood to run into the capsule, heats the empty portion of it before sealing that end. Then the area cooling the blood is drawn from the capsular end. This work is very fascinating, and anyone who has had the privilege of seeing Wright at work in his laboratory is impressed with the seriousness of the man and with the fact that his demonstrations have been very valuable contributions to modern scientific medicine. It would be impossible for such a one to fail to be convinced that he has demonstrated the existence of these bacterio-tropical substances in the blood serum. It is particularly on the lines of tuberculosis that this work has assumed importance, bringing forth as it does acute indications for exact dosage of tuberculin or other culture products used therapeutically. By following the opsonic curve of individuals under treatment, Wright has demonstrated the fact that much smaller doses of tuberculin are indicated than had been used by those who have relied on clinical evidence alone. A good deal of the work done in London both by Wright and Bullock, who is bacteriologist at the London Hospital, and is an ardent supporter of this work, has been done in the treatment of lupus. Their results with tuberculin in this disease have convinced them that treatment with Finsen light, X-ray and other irritating conditions are of value only by reason of the fact that they produce a hyperemia of the affected part, thereby flooding the lesion with blood rich in opsonic content. I recall one case of a girl with lupus, under Dr. Bullock's treatment, who had a very persistent lesion in spite of her opsonic index having been raised above normal as the result of the use of tuberculin. An ordinary old-fashioned poultice was sufficient to flood this lesion with opsonines, thereby causing very rapid recovery, when the fact was appreciated that hyperemia of the lesion was all that was necessary.

The practical difficulty in the way of the use of this valuable discovery in private practice is the difficulty, the result of the complexity of technic, and it is to be regretted that until this technic is very much simplified the opsonic work of Wright can not be placed in daily use by the busy clinician.

Dr. Porter—When you have a patient in whom you suspect tuberculosis, a low or variable opsonic index will give you confirmatory evidence. Wright has especially called attention to the fact that at times when a number of joints are affected, gentle massage of a single joint will cause not only that joint but other affected joints to improve. He attributes this to the fact that the massage has inoculated the patient to a slight degree. It is of some interest to know that it has been shown recently by Ross that an infant born of a tubercular mother has an opsonic index about equal to the mother's, which gives us an explanation why tuberculosis has been considered hereditary.

Amburg has shown that a bottle-fed baby has an opsonic index to all infections lower by far than a breast-fed baby. These facts explain a great deal

that heretofore has been conjectural. As to the statement of Dr. Evans that most work has been done on lupus, there has been a considerable amount done on lupus but an equal amount of research by Ross and others has been done for diseases of the chest in late and early tuberculosis, in which it has been shown that in tuberculosis of the lungs and in early disease of the bones we do get very definite and positive results, both diagnostic and therapeutic.

THE NAUHEIM TREATMENT OF ACUTE AND CHRONIC HEART FAILURE.

By PHILIP KING BROWN, M. D., San Francisco.

The Nauheim bath in connection with graduated and resisted movements has won a definite place in the treatment of chronic heart failure, and each year sees a wide range of heart cases favorably influenced by some modification of this system. The reproduction of the essential components of the bath in the form of easily-handled salts has permitted the bath to be taken to the patient, instead of the patient having to undergo the frequently exhausting journey to Nauheim, and the effort even when comfortably housed there of getting to the bath houses for treatment. It is of the artificial Nauheim bath that I wish to speak chiefly.

There are at Nauheim three principal springs used in the bath treatment, differing in chemical composition and in temperature. The ones most used are known as No. 7, No. 12 and No. 14. All are alkaline, effervescing springs of a temperature of 87 degrees to 92 degrees, and it is the active ingredients of these springs that most of the artificial Nauheim bath products seek to reproduce. The common form that most of these reproductions take, is illustrated by several of those that are extensively advertised, and which are merely two-pound packages of bicarbonate of soda and $1\frac{3}{4}$ pounds of acid sodium sulphate put up in the form of flat, round cakes and wrapped in oiled paper or tinfoil, or both. This protects them somewhat from moisture and from the action of the soda. The objections to this form of the bath are, that the chlorides, which form an important part of the ingredients, are omitted. The reasons are simple. The potassium and magnesium chlorides are expensive; the seven or eight pounds of sodium chloride which are necessary are very heavy, and the calcium chloride has so strong an affinity for water that it is handled with difficulty, besides being very irritating to the skin when handled in its solid form.

At Nauheim the calcium salt, known as "mutter lauge" is not a natural ingredient of any of the springs in sufficient quantity to be effective in the bath, but is added to the bath after it is drawn. It is a by-product of a neighboring chemical works, and is used because of its stimulating effect on the skin, augmenting and prolonging the effect of the CO₂ effervescence. Its import as a part of the bath is reflected by the bath attendants and patients alike, the latter often paying a few pennies for a more generous measure of the fluid. A further objection to the artificial

bath lies in the poor way the acid sodium sulphate is packed. Unless it is kept in a dry place it is bound to absorb moisture and crumble, and the free sulphuric acid escapes from the inadequate covering, leaving the cakes too weak to react later in the soda solution.

A use of two of the different forms of the bath for a year led me, on account of unsatisfactory results, to try the production of gas by releasing acid from bottles in a soda solution. This gave a very uneven effervescence, and it was hard to regulate it. Besides, the acid was hard to handle. At this point, I enlisted the services of R. R. Rogers, then professor of chemistry at Cooper Medical College, and we began a series of experiments to obtain more reliable acid sulphate and a means of handling it and the calcium chloride. To Mr. Rogers is due the credit of devising a paraffined paper box, the cover of which is put on after the acid sulphate or calcium chloride is put in, and while the paraffine is still warm. This enables it to be sealed in air-tight, and it requires no handling when the bath is prepared, for each box contains just enough for one bath. The acid sodium sulphate which we used at first was a waste product obtained in the manufacture of sulphuric acid by the old process of boiling. Before all the H₂ SO₄ has been removed, a point is reached when it is no longer profitable to continue the extraction, and at this point the product has about enough acid component to serve our purpose. It had the advantage or disadvantage of containing a good deal of iron, as the boiling is done in iron kettles, and this precipitates out in alkaline solution in the form of a heavy, rust-colored sediment. In this form it is a component of certain of the springs at Nauheim, but probably it has no advantage, and it is certainly disturbing from the point of view of cleanliness.

To obtain an acid sulphate free from iron, it was necessary to boil Glauber salts with sulphuric acid. A proper proportion can be estimated readily, and the end product when packed in the paraffine boxes will keep indefinitely without change. The proper proportion of the chlorides of potassium and magnesium was obtained in a sea salt in which the potassium and magnesium chloride existed as impurities. With the materials properly packed, it is a very simple matter to grade the strength of baths, as is desirable in the beginning with bad cases.

The advantages of the whole treatment at Nauheim are very great in a class of patients with nervous heart troubles who are better off far removed from social and business responsibilities. The hotels and private hospitals there are comfortable, some of them even quite luxurious, and it is certainly true that it is easier for some patients to do what every one about them is doing. Against this advantage is the distance to Nauheim, making it prohibitive in a large range of acute cases and in advanced chronic cases still in condition to be benefited by the treatment; the closing of the baths in winter; the effort of reaching the baths from the hotels, even when wheel chairs are used; and the lack of supervision in the bath, for the patient is turned over to an ordinary